VII

MILITARY ENGINEERING, MANAGEMENT, AND MOBILIZATION, 1976–1982

During the latter half of the 1970s and the first two years of the 1980s, the Army saw preparation for a war in Europe as its most critical and demanding task. The lessons of the Arab-Israeli War of 1973 were embodied in a new series of field manuals that stressed the importance of winning the first battle. The "come-as-you-are" war would be violent and deadly. The Army, confronted by superior forces, would have to conduct an active defense exploiting the firepower of its combined arms and the advantages of the defensive. With the warning time reduced from its previous levels, the Army had to be prepared to fight effectively from the first day. Otherwise the critical first battle might be the last, and American forces might find themselves driven off the European continent. The idea of a short, lethal war with little advance notice placed heavy demands on the Army.[1]

Although the older model of mobilization, based on the experience of World War II, seemed irrelevant to this new concept of a European war, the idea that mobilization could play an important role in the next war was not dead. The United States and its armed forces were not prepared for a rapid mobilization, as exercises in 1978 demonstrated. Furthermore, some strategists felt that America could not afford to ignore the possibility that the next war might turn into a long conflict that could make heavier demands than those experienced in World War II. Thus while the demands of the "come-as-you-are" war held center stage, new concepts of mobilization also began to occupy a place in American military thinking.[2]

Although these broad changes in American military doctrine affected the Engineer Studies Center (ESC), other changes, that were less dramatic from a national perspective, also shifted the course of the organization. In the 1960s and early 1970s, ESC had done pioneering work for the Army staff, but by the mid-1970s the Concepts Analysis Agency (CAA) and other study agencies assumed responsibility for many of these study categories. It appeared that the center's work might become duplicative and redundant until the Chiefs of Engineers of the period and ESC itself decided that the center should do more work for the Corps of Engineers and Engineer agencies on topics that were Engineer-related. ESC's work shifted from the long-range, Army staff studies that were

heavily quantitative to shorter-range, Engineer-related work that relied on more subjective and qualitative techniques. While the quantitative techniques of operations research/systems analysis continued to play an important role in its military engineering work, the center turned more toward the qualitative techniques used in its management analyses.[3] By 1981 its studies clearly identified it as an agency within the Corps of Engineers.

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In the late 1970s and early 1980s, studies in military engineering remained an important category of ESC's work. While the center studied other theaters, the geographic focus of this period was Europe. The numerical superiority of Warsaw Pact forces and the political significance of America's military commitment to NATO meant that American forces played a key role in the alliance's plans for halting an attack. Since the United States had found it too costly to station large numbers of troops in Europe, war plans called for the rapid reinforcement of NATO by units transported from the United States. Although much of the equipment and supplies for these units was already in Europe, the complex procedures for reinforcing NATO in a crisis required careful execution. In addition, European war plans placed great emphasis on exploiting those weapons or techniques, such as barriers, that could "multiply" or enhance the military effectiveness of the smaller NATO forces.

Even with reinforcements and multipliers, the formidable tasks that faced NATO troops in most scenarios required quick and efficient responses. Much of ESC's work in military engineering during this period concentrated on making the most effective use of the American Engineer forces and materiel in a European war. The effective use of Engineers required a thorough knowledge of tasks and a careful assessment of the capabilities of the force. In studies on a variety of topics, including airfield damage repair, NATO fuel supplies, and facility support, ESC familiarized itself with the European environment and began building the expertise that led to the *U.S. Army Engineer Assessment, Europe*—a broad and comprehensive survey of the Engineer role in a European war. Even though the projected Engineer workload in this war would be enormous, ESC has worked steadily to make it more manageable.

The many wartime support tasks of the Army Engineers include repair of damaged airfields. The Yom Kippur War of 1973 had shown that modern weapons could more heavily damage military airfields than was previously expected. As a result, the United States Army, Europe (USAREUR) asked ESC for new estimates of damage, and recommendations for repair techniques that could cope with the new damage levels. Using a computer model developed at the Air Force Armament Laboratory, the center projected the damage expected at certain American airfields in

Germany and investigated promising repair techniques.[4] In the fall of 1976 the American Army in Korea requested a similar study for Korean airbases, and ESC published the damage and repair estimates in early 1978.[5] Three years later the Army in Korea requested an update in light of new military developments, and that study effort was under way in 1982.

In 1977, ESC had focused on a broader aspect of Engineer support to the Air Force. The study compared the construction capabilities of the Engineer force with the minimum requirements of the Air Force.[6] The result was an analytic basis for "development of an Army position regarding the adequacy of the current Army and Air Force engineering force structure."[7] The study noted the problems in providing the minimum support to the Air Force and developed a list of projects that host nations might accomplish.[8] Although airfield repair and construction support to the Air Force are only a part of the Engineers' wartime functions, changing weaponry, technology, and strategy necessitated periodic review of the tasks to determine the required Engineer effort.

During wartime, Engineers also provide temporary bridges to enhance the mobility of American forces. Predicting the number of tactical bridges required in any theater is difficult because the number depends heavily on the particular battlefield situation. However, technological developments in the mid-1970s offered the promise of more flexible, lighter, and more adaptable temporary bridging elements.[9] A study team from NATO nations had proposed a new bridging system, called the "common girder" system, which would "consist of standard ramps and sections which may be combined to form girders and bridges of many useful lengths."[10] In addition to the advantages of interchangeable parts, the new bridge components weighed only half as much as the older components. Although the common girder system seemed to have great possibilities, the Engineer School at Fort Belvoir asked ESC to investigate it more thoroughly.[11]

The study published in May 1976 concluded that the new bridging was an important development. The Yom Kippur War had indicated that heavy tank damage on the battlefield would necessitate more armored vehicle movement to and from the front lines. Moreover, tactical bridges themselves might be more vulnerable to the new antiarmor weapons. ESC felt that the new technology should be strongly supported, but it feared that "the Army is so conditioned by extravagant claims for hardware"[12] that it might underrate the important advantages of the new system: "Instead of underreacting, the Army should be aggressive in its support of continued development along bridging family lines."[13] The new concept could markedly improve the Engineers' capability to provide tactical bridges on the battlefield.

While airfield repair and tactical bridging were two significant Engineer support tasks, studies like the *Engineer Estimate, Europe* had

shown that barrier and obstacle construction would be the most demanding Engineer task in a European war. In the early 1970s, this heavy commitment of Engineer resources had been questioned, and in 1976 ESC again examined the effectiveness of obstacles in combat. Noting that "the measurement of obstacle effectiveness has remained primitive and produced unconvincing results,"[14] ESC wrote a broad, impressionistic survey of the field for the Deputy Chief of Staff for Operations (DCSOPS).

The center noted that in spite of lingering doubts about barriers, there were new reasons for interest "because many of the other battlefield options have become so expensive and require special skills. Many people now wonder whether obstacles in one or more of their forms may offer much needed economies."[15] In their attempts to assimilate the lessons of the 1973 Middle East war, some American military analysts had gained new faith in obstacles because of their role in helping the Israelis stop the surprise Arab offensives in the Sinai and on the Golan Heights. Although none of the combatants in the 1973 war had made successful deep penetrations through enemy lines, ESC felt that this was due less to obstacles or the effectiveness of modern weapons than to the restraint shown by both sides, neither of which wanted to push their offensives far enough to trigger great power involvement in the conflict.[16] The Army was seriously concerned about deep penetrations by an enemy because American forces might encounter similar problems in a European war. In ESC's opinion, however, the October war provided very few lessons about stopping deep penetrations because "neither side tried to make very deep penetrations."[17] For ESC the lessons of the war were less comforting: "The Israelis suffered heavily on both fronts, despite the evidently lower level of professionalism among the Arabs. What remains is the awesome specter of a less professional, more numerous enemy with qualitatively equal equipment having come very close to succeeding completely."[18]

From its survey of the role of obstacles in other modern wars, ESC concluded that obstacles and fortifications did decisively affect some battles, but the time and effort needed for their construction were beyond practical consideration for the American Army in Europe. In other instances where less effort had been devoted to obstacle construction, the barriers had not had a decisive impact on the outcome of the battle. Because the results of its investigation remained inconclusive, ESC felt that only a more comprehensive study effort could decide the issue.[19] "Relative to some other very expensive weapons requiring exceptional skills, obstacles may offer potentially high pay-off for short-term low investment. If so, increasing the effort devoted to obstacles would be justified. If not, current and planned obstacle effort should be redirected to more useful battlefield purposes."[20] Even though obstacle construction was a major Engineer responsibility, ESC believed that its usefulness should be carefully evaluated in order for it to remain an important aspect of military doctrine for a European war.

Although two other studies of Engineer problems in Europe dealt more with Army organization than military engineering, they were part of the process by which ESC familiarized itself with the Engineer environment in Europe. In a study published in 1976, the center developed a concept for converting the peacetime Engineer Division, Europe, which was concerned with contract construction, facilities engineering, and real estate, into a wartime Engineer Command.[21] Later in 1977, ESC examined several problem areas in the wartime organization of USAREUR.[22] Both studies contributed to the center's understanding of the details of theater organization in Europe.

In 1978, ESC continued its studies of Engineer support tasks during a conflict in Europe by examining the role of critical facilities in the rear combat zone (RCZ).[23] The center identified the RCZ functions most important for assuring the survival of USAREUR and determined which facilities USAREUR needed to perform these functions. Because a minimum of support was emphasized, the most important tasks involved repair of damage caused by bombing, airborne troops, or saboteurs. The other Engineer support tasks relating to facilities, new construction, and maintenance received much lower priority because the Engineer workload for the first 30 days of a war was already enormous. Based on the estimates of the Warsaw Pact threat and the priorities accorded to different missions, the study outlined the "minimum essential engineer support capability required to ensure continued operations" by USAREUR.[24]

Almost three years later, in May 1980, ESC published a broader study of facility support policies. Unlike the earlier study, this one examined structures in the RCZ and the forward combat zone (FCZ), including weapons emplacements, tank obstacles, and hasty road repairs. Since the study emphasized the first 30 days of combat, ESC recommended a minimum of new construction with priority given to austere support concentrating largely on repairing damage to critical facilities.[25] "The anticipated daily enemy air attack," the study noted, "will mean an immediate and continuous effort to repair bomb damage."[26] ESC determined that damage repair and combat engineering tasks in the FCZ would absorb most of the Engineer capability, leaving little potential for new construction or maintenance for at least a month. Commanders would have to make maximum use of existing American and host-nation facilities and rely on their soldiers to accomplish simple tasks like erecting tents, providing camouflage, and clearing rubble.[27] While the second study was broader in scope than the first, it was clear from both of them that the Engineer force in Europe would be adequate only for minimal facility support tasks, and the substantial threat from the Warsaw Pact air forces meant that damage repair would have to take first priority.

Most of ESC's work on Engineer support tasks concerned "winning the first battle in Europe," which was also the subject of a large study

directed by the Engineer School during 1977 and 1978. The Engineer Family of Systems Study (E-FOSS) sought to identify "developmental priorities for organizations, equipment, doctrine, and training which will maximize combat engineer contributions"[28] to winning a war in Europe during the period 1978 to 1985. ESC and other Army study agencies conducted a workshop, during which representatives of all the Army branches calculated their requirements for Engineer support. The study agencies analyzed these requirements and suggested improvements in combat engineering. The center also wrote the manual that described the procedures for the participants.[29]

In addition, ESC provided an important data base for the agencies involved in E-FOSS. In April 1978 the center published a study that estimated the Engineer manpower and equipment required for more than 50 tasks.[30] With this data base and the results of the workshop, ESC determined the Engineer resources needed on the battlefield to support the Air Force, provide maps, and supply water for the troops.[31] E-FOSS, like the more specialized ESC studies, was another attempt to match the Army's demands for Engineer support with Engineer capabilities.

Prior to 1978, ESC had studied specific problems involving Engineer wartime support, such as airfield damage repair, or had contributed to larger studies, such as E-FOSS. In 1978 the center began a series of broader studies that examined the role of Engineers in the European theater, first at the corps and then later at the Army level. Changes in Army doctrine, including the short-war scenario, and the renewed emphasis on Europe forced both the V and VII Corps stationed in West Germany to reexamine their operations plans. Because this reevaluation was more than the corps' Engineer staffs could accomplish given their day-to-day operations, they asked ESC to undertake the assessments.[32] The studies of both corps' war plans compared the tasks that an attack would place on the Engineers with the resources of men and materiel that the plans allocated to the two corps. Both studies focused on the feasibility of the obstacle plans, which would require a large effort. After comparing requirements and capabilities, the studies recommended ways to compensate for shortfalls and improve the use of Engineer resources. While none of the specific recommendations called for dramatic or unrealistic changes in the Engineer posture, ESC felt the total effect of these recommendations would improve the Engineers' ability to provide support in a European war.[33]

In the spring of 1981, the center updated the V Corps plan, which needed revision because the original study was now almost three years old and the Corps had modified its war plans in the interim.[34] In order to complete these corps-level studies, the center conducted a similar examination of the III Corps plans that covered that organization's deployment to Europe.[35] Both studies covered the first month of the wars, making them compatible with the earlier VII Corps study. As with earlier corps studies,

the center provided recommendations that would assist the corps Engineers in establishing priorities for tasks and in determining methods for accomplishing or modifying them to suit the Engineer troop and materiel levels. These four corps-level studies provided the foundation for ESC's review of the whole European theater.

By 1979, ESC had amassed a great deal of experience in Engineer planning and analysis for the Army in Europe. The specialized studies on airfield damage, facilities support, and NATO fuel supply among others, as well as the corps-level plans, had equipped the center for its most comprehensive survey of wartime Engineer resources and requirements. In April 1979 the USAREUR DCSOPS and DCSENGR (Deputy Chief of Staff for Engineering) asked ESC for a theater-wide assessment that would integrate and synthesize the many specialized studies and any new insights that a theater-level analysis might uncover.[36] Not since the *Engineer Estimate, Europe* (EEE), published in 1971, had the center undertaken such a large-scale project for any theater. The new assessment differed from the EEE. It was more detailed and covered all American forces that would be sent to Europe in the event of a war.[37] ESC began work in the fall of 1979 and published the *U.S. Army Engineer Assessment, Europe* (EAE) in four volumes in June 1981.[38] The EAE became the largest theater-level study that ESC had ever undertaken.

The EAE was comprehensive and intended to make the best use of Engineer resources currently allocated to the theater. The purpose of the EAE was

> to determine how U.S. Army engineers can best support U.S. forces in Europe when engaged in a NATO/WP conventional (non-nuclear and non-chemical) conflict. This broader purpose was achieved by a comprehensive assessment of engineer support requirements and capabilities that identified gaps and imbalances in engineer resources (troops and materiel) and determined actions needed to reduce or eliminate these and other deficiencies. The assessment was made in full recognition of a resource-constrained environment. It is assumed that the engineer force, measured as a percent of the total force, cannot be increased in size.[39]

Like the corps-level studies, the tasks expected of Engineers by USAREUR war plans were compared to the work that the Engineer units stationed in Europe and those to be deployed there could reasonably accomplish. By 1979, ESC knew that too few Engineers would be in Europe and that increasing the number was unlikely.[40] The problem became the use of troops and materiel in the most effective manner.

ESC conducted the EAE in two phases. The first concentrated on mobilization and the first month of war, covering the first critical battle in great detail. The second covered the next five months in less detail. Because certain topics, such as atomic demolition munition (ADM) employment and

topographic support, had already been sufficiently analyzed, ESC did not cover them again. The center examined the various Engineer tasks and established priorities for their accomplishment. It compared the workload and resources in the FCZ with those in the RCZ and examined possible shifts and tradeoffs between zones and between the three corps.[41] The basic goals were "adequacy in engineer plans and policies, consistency in engineer support priorities and procedures, balance in engineer unit and equipment workloads, and uniformity in the effectiveness of engineer support."[42]

The result of the EAE was a lengthy set of recommendations for improving the Engineers' performance of wartime tasks:

> The study identifies changes required in engineer support priorities (e.g., survivability versus mobility, damage repair versus new construction), force structure (e.g., float versus fixed bridge companies, bridge companies versus combat support companies), and engineer task assignments (e.g., HN [host nation] versus U.S. engineers, heavy combat engineer battalions versus corps engineer battalions). The study also determines the proper mix and level of OP [operational project] stocks (e.g., bridging materials, barrier materials).[43]

The specific recommendations included force structure changes, reallocation of Engineer resources, changes in Engineer unit design, and adjustments in the level and mix of operational project stick. EAE urged standardization of estimates for Engineer support requirements, establishment of priorities for support tasks, deferral of low-priority tasks, and assignment of some tasks to the host nation.[44] Following these recommendations, ESC felt, would focus Engineer effort on the most important tasks and make the most efficient use of limited Engineer resources.

Even with implementation of the EAE's recommendations, a war in Europe would cause grave problems:

> All of the initiatives proposed above are therefore directed towards maximizing the effectiveness of the engineer force within fixed manpower ceilings. While the proposed initiatives will go a long way towards correcting the imbalances and shortfalls at D + 30 and beyond, they will not correct the shortfalls at D-Day. Even with all the engineer planning initiatives, the OP stock initiatives, and other initiatives (i.e., peacetime construction, improved combat support equipment companies, increased HNS [host-nation support], more dozers for the FCZ, new obstacle materiel), there will still be a critical shortage of engineers at D-Day. The only apparent way to correct this shortfall is by expanding the size of the D-Day force.[45]

According to ESC the D-Day force could be increased by expanding the peacetime force in Europe or by increasing prepositioned overseas materiel configured to unit sets (POMCUS) stocks to support accelerated deployment of additional units from the United States.[46] Although the EAE had assumed that the force in Europe would not be expanded, the center

discovered that the total effect of implementing its recommendations would still not provide an adequate Engineer effort for the critical first battle in Europe (see figure 35).

As an adjunct to the primary EAE study, ESC produced a series of ten monographs. These shorter volumes were directed toward specific audiences and covered in greater detail problems revealed by EAE. A substantial portion of the forces with which USAREUR would fight a war are stationed in the United States and must be transported to Europe. Most of the Engineer units to be deployed are reserve units. While most studies assumed that these units are fully manned and equipped, ESC decided to investigate this assumption in order to arrive at more realistic figures about the number of troops that would reach Europe. In the monograph, *Engineer Force Capability*, the center examined the readiness of units for deployment to Europe, calculated the number of casualties in Europe that would have to be replaced as the war progressed, and, after subtracting casualties from the deployed force, arrived at figures for the numbers of troops and amounts of equipment that would be available in the theater after D-Day.[47]

In another monograph the center returned to the subject of bomb damage to critical American facilities in Europe. An ESC study published in 1976 had examined bomb damage, but improvements in the Warsaw Pact air forces necessitated revision. The center posited two scenarios: one with a short (two-day) warning and another with a ten-day warning. Using these scenarios ESC estimated the number of planes that would be directed against American facilities, the number and size of the bombs they would drop, the attrition rate for Warsaw Pact aircraft, and the amount of damage these attacks would produce over time. After calculating the expected damage, ESC recommended measures to reduce damage and methods for including damage estimates in theater planning.[48] A companion monograph updated ESC's earlier work on techniques for repairing damage to airfields.[49] American forces had not confronted the prospect of a serious air threat since World War II, and ESC felt that the Army in Europe needed to prepare for it carefully.

In addition to war damage repair, Engineers also were responsible for improving the survivability of American troops and equipment. Under conditions expected in a European war, the primary mechanism of survivability would be protective construction consisting of austere field fortifications dug by heavy equipment. Although the value of protective construction had long been recognized, it was not included in many war plans because commanders felt such construction would consume too much of the already strained Engineer resources. ESC concluded that simple field fortifications could protect units effectively and impose higher casualties on the attacker. While the amount of Engineer effort depended on the terrain and the characteristics of the unit, the center felt that with sufficient warning Engineer units could provide protective construction that would substantially enhance the effectiveness of the American forces in Europe.[50]

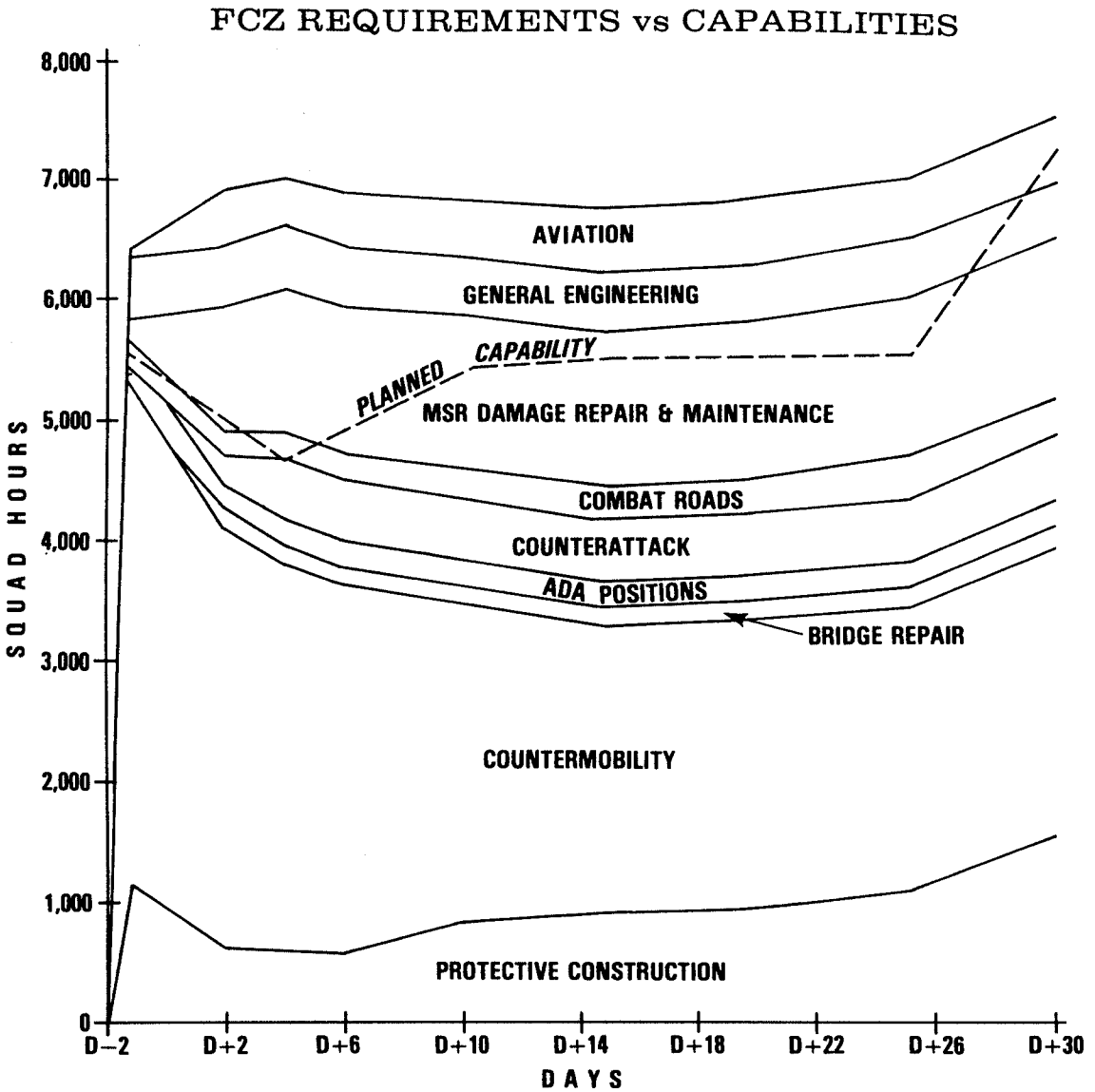

Figure 35

Providing troops with increased mobility on the battlefield is another engineer task, and in an EAE monograph ESC examined the requirements for tactical bridging. "Tactical bridging," ESC noted, "may not be needed often on the battlefield; but, when needed, it frequently is critical to the success of the tactical mission. Perhaps no other tactical support system has requirements so sporadic, yet so critical when they occur."[51] ESC chose four representative sectors along the front, and using computer simulations of the battlefield, calculated the types and amounts of bridging that would be needed. After comparing these estimates with stocks in the theater, the monograph recommended several actions including "new theater stockage levels, relocation of in-theater bridge stocks, and changes in the tactical bridging force structure."[52] A related monograph examined USAREUR's

operational project stocks for obstacles and tactical bridging materiel and recommended measures to correct deficiencies and imbalances.[53]

In another EAE monograph, ESC analyzed the peacetime structure of the USAREUR Directorate of Engineering and Housing, which performed real property maintenance activities (RPMA), and made recommendations about how it could be used in wartime.[54] Both the *III Corps Engineer Assessment* and the update of the V Corps assessment were included in the list of EAE monographs. These specialized studies covered a broad range of topics including certain Engineer wartime missions and wartime organizations. The *U.S. Army Engineer Assessment, Europe* as a whole provided a comprehensive and detailed evaluation of the USAREUR Engineers' wartime tasks and capabilities and was intended to be used as a guide for the Engineers in Europe well into the late 1980s.

Although it was not part of the EAE, ESC's study of the family of scatterable mines (FASCAM) was requested by the NATO advisor's office, and mine warfare was a subject of considerable interest to the European theater.[55] Mines, which are an integral part of barrier planning, impose casualties on an enemy and restrict or canalize his movement. Although mines are "force multipliers" that could play an important role against a particularly severe armored threat, emplacement of conventional mines requires a great deal of time and effort. Moreover, they can restrict the movement and flexibility of friendly forces as well as those of the enemy. The new scatterable mines can substantially reduce emplacement time because they are smaller and lighter, and can be distributed by helicopters, artillery, or other mechanical means. In addition, the scatterable mines self-destruct after a certain period of time and therefore do not constitute a permanent barrier to friendly mobility. Because of its versatility, however, FASCAM could actually complicate a commander's command and control problems, especially since the doctrine for using it is still being developed. Like many new weapons systems, FASCAM is more expensive than conventional mines, and because the mines are scattered on the surface, they may be easier for an enemy to detect.

In spite of its liabilities, FASCAM represented for many people a major breakthrough in mine warfare, and some Defense Department officials, like NATO advisor Robert Komer, felt the program was not receiving sufficient support. ESC concluded that mines were at a disadvantage in competing with "highly visible weapons systems,"[56] and that mine warfare also suffered from some of the problems that plagued barrier planning as a whole. Although mines produced a number of effects on the battlefield, the only impact that had been clearly demonstrated was the casualty-producing one. According to the study, "one of the basic weaknesses in all evaluations of minefield effectiveness is the inability to model their multiple and often intangible effects."[57] As in the case of obstacles, their effectiveness was easier to assert than to prove, and thus the effort and expense involved in

their use was difficult to justify. The study concluded that FASCAM still offered substantial advantages over conventional mines and that the program deserved additional attention and faster development.

In 1982, ESC continued its military engineering work related to the European theater. *Peacetime Defensive Preparations, Europe*, published in March, examined the measures that could be accomplished prior to the outbreak of war to enhance the defensive value of natural obstacles and man-made features along the West German frontier.[58] Returning to the themes found in its barrier planning, ESC recommended engineering alternatives, including antitank steps on river banks and canals and modified bridge abutments, which could be emplaced during peacetime without major legal, political, or diplomatic objections. The study urged that a comprehensive NATO program be undertaken as soon as possible.

Early in 1982, ESC began work on another Engineer Estimate for the VII Corps.[59] The 1979 Estimate had concentrated on Engineer capabilities, whereas the 1982 Estimate concentrated on requirements. The center relied on EAE for the study's framework and used war games to generate the requirements. While the earlier Estimate had confined itself to conventional war, the new one included recently developed integrated scenarios involving tactical nuclear and chemical weapons. The 1982 Estimate, therefore, looked at the VII Corps Engineers' wartime role from a different perspective.

The Mission Area Analysis (MAA), begun in 1982, was also based on integrated scenarios.[60] The Training and Doctrine Command (TRADOC) assigned the Engineer School responsibility for analyzing the battlefield missions and tasks in combat support, engineering, and mine warfare, and ESC conducted part of that analysis. The MAA focused on the last years of the 20th century and sought to define the roles and capabilities of combat support, engineering, and mine warfare forces; identify deficiencies in doctrine, organization, and equipment; and propose corrective measures. ESC's study of the general engineering functions was one aspect of a broad evaluation of the Army's capabilities and deficiencies at the end of the century.

In addition to the substantial amount of work done for the European theater, ESC has also devoted more attention to the Korean theater. In July 1982 the center completed a lengthy study evaluating the barrier plans for the South Korean border.[61] The study evaluated the North Korean threat and examined the terrain along the frontier, paying particular attention to conditions that affected the movement of tanks. Using this information, ESC assessed the existing barrier plans considering the density, mix, and effectiveness of obstacles. The study concluded with recommendations for improving the plans and developed an automated obstacle data base for use in South Korea. The five-volume study indicated the center's continuing interest in barrier planning.

While ESC studied other geographic areas, the bulk of its work in military engineering in the late 1970s and early 1980s concerned the European theater. In the mid-1970s, with the renewal of the Army's interest in Europe, the center worked on a variety of specialized topics. As the organization accumulated information and experience, the Army in Europe requested broader studies, first at the corps and then at the theater level. The EAE culminated almost a decade of work on Engineer problems in Europe. ESC and its Program Office in Europe continue to provide analyses for the theater that American strategists believe may be the most critical one in the world.

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In the late 1970s, ESC became more heavily involved not only in military engineering, but also in management analysis. Earlier, ESC had done most of its work for the Department of the Army staff, but the two Chiefs of Engineers in the late 1970s, Lieutenant Generals William Gribble and John Morris, wanted the center to do more work for the Corps of Engineers. Both felt that the Corps needed to improve its management and organization, especially when the Carter administration threatened to deprive the Corps of its civil works mission, and ESC was one of the few Engineer agencies with experience in management analysis. ESC's management studies for the Corps had begun in the early 1960s, and as the Concepts Analysis Agency (CAA) took over the large-scale, long-range Army studies of subjects like force requirements and force structuring, ESC turned to military engineering and management studies sponsored by the Chief of Engineers and other Engineer agencies.[62] The center began to do less work with quantitative, operations research/systems analysis techniques and according to Brigadier General Donald Weinert, commander of ESC from 1975 to 1977, "strengthened its capability in the less tangible managerial field."[63] Management analysis, therefore, became a major field of endeavor for ESC in the late 1970s, as the organization devoted more of its attention to the organizational and managerial problems of the Corps of Engineers.

In May 1977, an important management study recommended the reorganization of the headquarters of the Chief of Engineers.[64] In place of the single executive officer who assisted the Chief and Deputy Chief of Engineers, the study proposed the establishment of two positions, a chief of staff who would manage the OCE staff and an executive officer who would "concentrate more on executive and administrative matters."[65] ESC itself would move from the Directorate of Facilities Engineering and report directly to the Deputy Chief. The most far-reaching recommendation, however, called for forming a Resource Management Office (RMO). In ESC's opinion the Corps needed an agency that looked at all the Engineers'

activities from a broad perspective, integrating and supervising Corps' missions and budgets and providing long-range planning.[66] In addition, the RMO "monitors and evaluates program progress, results, and costs and feeds back to program managers information they need to control operations. Further, the job includes analyzing economic, social, and political changes, and looking ahead at their potential impacts on the Corps."[67] In ESC's conception, the RMO would be an "honest broker" for the Chief and the program managers, providing the overall direction that would allow the Corps to plan and undertake activities that were feasible and fitted into a coherent whole.

In his foreword to the study, General Morris ordered the implementation of several of the study's recommendations, including the two new positions at the executive level and the new position for ESC. The most controversial recommendation, establishing the RMO, was only partially implemented. ESC assisted in establishing the RMO, but the new office concentrated on long-range planning with programming and budgeting left in the hands of the mission directorates.[68] While this fell short of ESC's full program, it provided the Corps with improved capability to coordinate and evaluate planning for the future.

Two months later ESC turned to the Corps organization of Divisions and Districts in the field. In studying the field organization within the United States, the center relied on three management tools that it had developed or refined in the mid-1970s: workload analysis, force or personnel stratification, and performance measurement. The workload measure allowed the Corps to calculate the total amount of work being done by the Districts and Divisions and the amounts in major subcategories (such as planning, engineering, construction, etc.) within the total workload. Performance measures gauged the progress of the Districts in completing projects in, for example, design or construction. ESC had developed the final measure, force stratification, as an outgrowth of its earlier work on force stratification for the Army as a whole. Corps stratification, as it was called, looked at the allocation of personnel according to the function they actually performed rather than their organizational location. The field organization's work was broken down into functional categories, such as planning, engineering, construction, operations, and support. Using corps stratification it was possible to compute the proportion of an organization's staff devoted to each function and to compute a corps "tooth-to-tail" ratio relating mission and support elements.[69] These management tools allowed the managers in the field as well as at OCE to measure the performance of their organizations and to correct problems.

The Field Review Study of 1977 began with the sensitive subject of personnel allocations.[70] In conjunction with the directors of Civil Works and Military Programs, ESC surveyed the current distribution of manpower among the Divisions and Districts and recommended new allocations based

on "current personnel strengths, anticipated workload in FY 78, and projected long-range workload trends."[71] To prevent the Corps from losing critical expertise in areas such as lock design or hydropower planning, the study urged the establishment of "centers of competence" in which skills that were threatened by lack of workload or fragmentation could be concentrated in fewer locations. The centers would then support other Divisions or Districts as needed. Another policy that ESC believed could help keep the Corps from losing expertise was "fencing." In fenced areas, such as hydropower planning or flood control, the Corps would do all the work in-house, thereby preserving the workload and the skilled personnel.[72]

While ESC felt that the Corps should avoid contracting work in areas that were critically important to the future of the Corps, it also felt that routine, less critical work, such as maintaining the revetments along the Mississippi River, should be contracted, freeing personnel spaces for more important tasks. Although ESC stated that certain skills should be preserved at some location in the Corps, the center recommended that some Districts, in which the workload in certain areas had decreased drastically, should be "tailored." In these Districts the underutilized functions would be curtailed or eliminated and the tailored District would rely on another one to perform its functions in these areas.[73] As the final element in its review of field organization, ESC investigated the length of time it took to complete most civil work studies and designs. Although the center recognized that external pressures caused many delays, it concluded that "there are significant delays due to internal reasons":

> Constant changes in Corps policy and delays in enacting these policies appear to be at the heart of the problem. Enactment of policy is often delayed until specific problems arise. Formulation of policy then becomes a matter of "putting out fires." The problem with this approach is that much time is lost by Corps field elements in preparing "strawmen" to be tested by OCE. It is felt that this situation exists because of OCE's reluctance to give up its review function and devote its time to establishing policy. While it is recognized that change in policy is necessary, change for change's sake is not.[74]

Thus while substantial alterations and reallocations of personnel and workload in the field were required, ESC felt that to improve efficiency in the Districts and Divisions, OCE also had to reexamine its mission and functioning. Although the Corps did not enact all of ESC's recommendations, certain actions such as tailoring and establishing centers of competency have become a part of Corps policy.

Prior to its studies of Corps organization, ESC had become involved in an examination of the training of Corps civilian employees. By the late 1970s a substantial number of civilian employees were reaching the retirement age, which meant that the near future would bring a large influx of new employees and many old employees would be new to their jobs. At the same time the nature of the Corps' work appeared to be changing: "There

seems to be a clear trend toward more contracting of designs and studies. Many perceptive field managers believe it is a fundamental change. They see the Corps as becoming the manager of studies, design, and construction rather than the 'doers.' "[75] Both the changes in the civilian work force and in the work itself necessitated, according to ESC, a reevaluation of training policies.

After investigating the Corps training program, ESC concluded that "the level of employee development is too low in terms of time invested."[76] The weaknesses were not in professional and technical training where the Corps continued to be strong, but in managerial training. In the past the Corps had stressed technical training up to the level at which jobs become primarily managerial, and people arrived at these jobs without training for supervision and management. The result was "that Corps management is weak compared to what it could and should be."[77] ESC recommended an increased emphasis on training in general and on managerial training in particular.

As a consequence of the ESC study, the Chief of Engineers established a Training Committee and designated the Huntsville Division as the training division of the Corps. The center provided support for the committee and wrote a manual on management development for District Engineers. The committee adopted ESC recommendations for programs to foster career paths for managers and to identify and train employees who had demonstrated managerial potential. After examining the nature and costs of existing training programs, ESC and the committee outlined changes to make training more effective and less expensive.[78]

While ESC followed up on its 1977 study of civilian training, it was assigned a large study relating to the Corps work force. The October 1977 Division Engineers Conference singled out the quality of the work force as a topic of special importance, and the Resource Management Office eventually assumed sponsorship of a large ESC study effort on the future needs of the Corps work force. The result was a broad study entitled *Developing and Managing the Corps Work Force for Future Missions*, published in July 1980, and a series of five monographs on related topics.[79]

In order to prepare the Corps and its work force for the future, ESC felt that the Corps' leaders should determine the investments it needed to make in developing and managing the Corps' employees "to assure that the Corps will have people sufficient in number and with the skills and capabilities needed to do the job in the next decade."[80] A number of factors made this determination particularly difficult. During the Presidential campaign of 1976, Jimmy Carter had raised the prospect once again of stripping the Corps of its civil works functions—an action that would have affected seriously the Corps' civilian employees who worked primarily in that area. Even though the Corps kept its civil works mission, that function was

already experiencing substantial changes: "The traditional Corps missions are necessarily changing because traditional demands are being exhausted."[81] After more than 160 years of completing water projects, the list of new ones was diminishing, and the increased concern over the environment meant that new projects received more intense and critical scrutiny. While ESC believed that opportunities for new missions abounded, the Corps work force, which would have to undertake these new tasks, was still in a period of transition and instability. The center predicted that in the first half of the 1980s, 25 percent of the work force would leave their jobs and 65 percent would be new to their positions. In addition, ESC felt that the Corps might have difficulty in finding top-level managers because the age cohort expected to fill these jobs (people born in the 1940s) was a small one (see figure 36).[82] The changes in Corps missions and in the work force meant that many people would be new and perhaps unprepared for their jobs.[83]

The center had already identified several skill shortages in its earlier studies of training. The most severe shortage would be in management, especially of project managers and general managers "with a broad understanding of all major aspects of the business process at the district and division level."[84] ESC also predicted that even if the Corps continued its traditional missions, major shifts in the skills of its work force would be required. Trends indicated that the Engineers would contract more of their engineering and construction work to private firms, decreasing the number of personnel in those areas, while more Corps employees would become involved in planning, operations, and support (i.e., legal services, data processing, and administration) (see figure 37). Ironically, these projected needs corresponded closely to the skill shortages in the current work force. The addition of new missions that were not closely related to the traditional ones would complicate the prospects even more.[85] In ESC's opinion, therefore, the Corps could face serious work force problems in the 1980s unless it began preparing for the future immediately.

The center began a series of recommendations by emphasizing again the need for more intensive training of the work force. Although the Corps spent more on training than did most federal agencies, the demands of the future meant that the Engineers should at least double their training budget. In addition to more management training, ESC felt that the Corps needed to train for likely future missions in fields such as mobilization, hydrology, and real property maintenance activities support to the Army. While new missions were hard to anticipate, ESC believed numerous prospects existed, including an increased emphasis on hydropower due to the energy crisis and large international programs like the one in Saudi Arabia. Even though many of these prospects might be exciting, ESC warned that the Corps must keep firmly in mind its primary mission, support to the nation in the eventuality of mobilization and war. In the future the Corps might need to seek

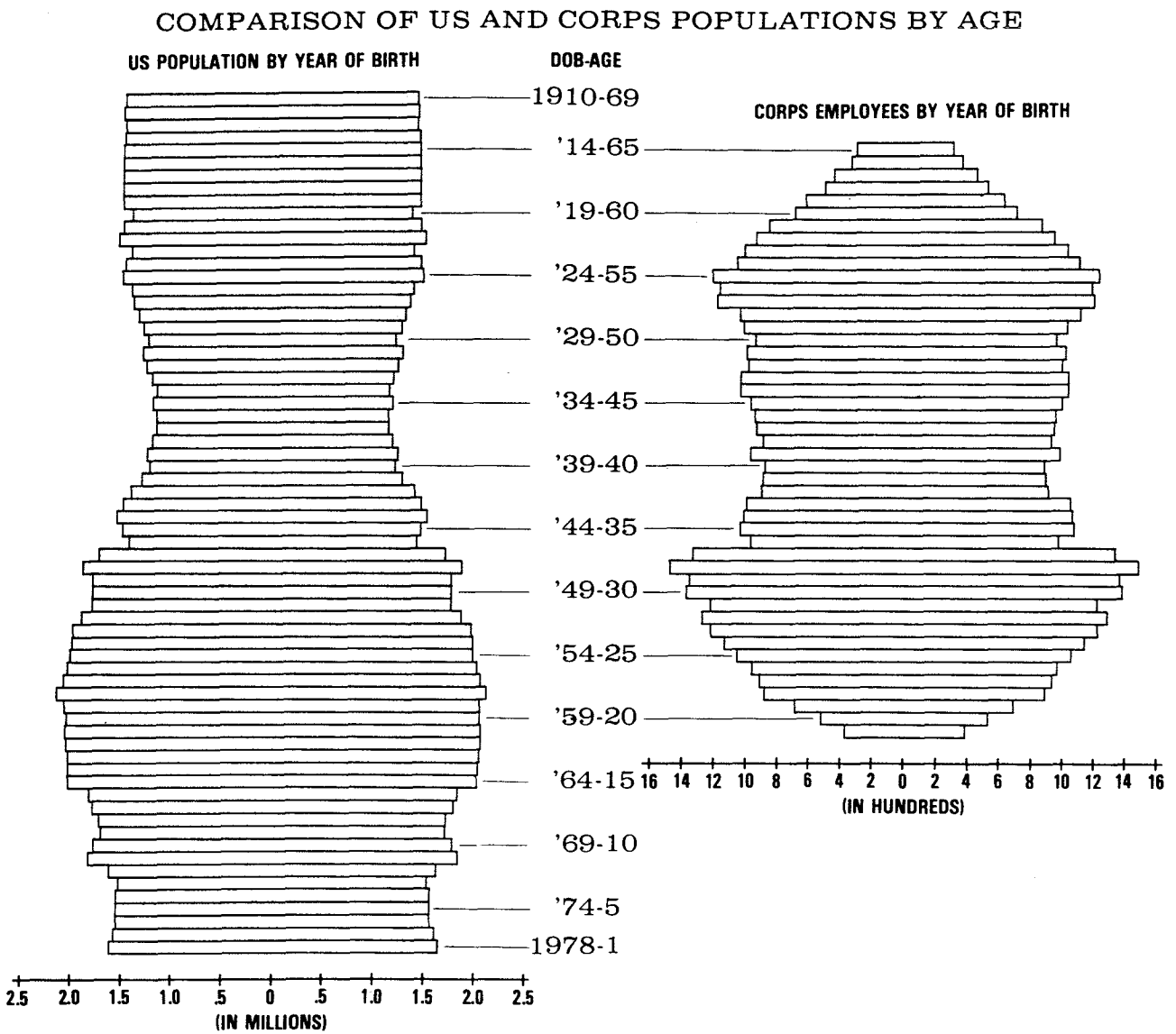
COMPARISON OF US AND CORPS POPULATIONS BY AGE
US POPULATION BY YEAR OF BIRTH
DOB-AGE
1910-69
'14-65
'19-60
'24-55
'29-50
'34-45
'39-40
'44-35
'49-30
'54-25
'59-20
'64-15
'69-10
'74-5
1978-1
2.5 2.0 1.5 1.0 .5 0 .5 1.0 1.5 2.0 2.5
(IN MILLIONS)
CORPS EMPLOYEES BY YEAR OF BIRTH
16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16
(IN HUNDREDS)

Figure 36

SUMMARY OF FUNCTIONAL TRENDS FOR TRADITIONAL MISSIONS

FUNCTION	PROPORTION OF WORK FORCE 1978 (%)	1990 (%)	CHANGE
PLANNING	6.8	11	UP 60%
ENGINEERING	20.9	19	DOWN 10%
CONSTRUCTION	11.1	10	DOWN 10%
OPERATIONS	38.9	45	UP 16%
RE	4.6*	4.5	DOWN 2%
SUPPORT	16.4	17	UP 4%

* 1979 DATA

Figure 37

out new peacetime missions that fostered the skills necessary for mobilization and war. In any event, training for mobilization in particular should be emphasized.[86] In ESC's opinion, the Corps training program should be well funded and flexible, providing education in areas of existing skill shortages and also in areas that seemed likely to become Corps concerns.

In addition to increased training, ESC recommended better management of the work force. The Civil Service Reform Act of 1978 seemed to offer valuable opportunities for improving management, because "for the first time since the Civil Service System was established, employees will be evaluated and accountable for specific performance."[87] Job appraisal under the new system would be based on explicit performance standards worked out between the supervisor and the employee. Proper implementation of the act should be "aimed at identifying the individual's full potential, enhancing personal growth and development, and for the first time, making individuals accountable for specific performance."[88] At the same time ESC felt that the Corps should enhance its attractiveness as an employer by establishing career paths with the promise of viable on-the-job training and by instituting "insightful and unbiased selection and promotion practices."[89] Many Corps supervisors had already complained that upper-level positions were difficult to fill because civilian employees were reluctant to move to a new locality in order to take a better job. ESC studied work force mobility and discovered that in fact employees were willing to move, especially at the higher grade levels.[90] Finally, the center once again urged consolidating activities in one office, the Civilian Personnel Office, where most of the authority already resided.[91] The combination of better training and better management should, according to the center, prepare the Corps work force for the new decade.

Although ESC did most of its work in management analysis for Engineer agencies within the United States, the center did four studies in 1978 for the Middle East Division (MED). As a result of an agreement between the United States and Saudi Arabia, the Corps of Engineers was asked to supervise and manage several large construction projects in that oil-rich nation. The Division Engineer in 1977, Brigadier General Richard Wells, had been an analyst at ESC in the 1960s and knew that the center had accumulated considerable experience in the field of management analysis. The Saudi program was an enormous one involving billions of dollars and the considerable difficulties of managing large construction projects far from the United States and in a developing nation.[92] In December 1977 General Wells asked ESC to "develop a formal planning system encompassing the major construction projects and the MED 'total program.' "[93] Because of the magnitude of the task, ESC first concentrated on developing a format for planning the individual projects. Project planning was complicated because of variations in the levels of funding and numerous changes in design specifications and in construction scheduling. ESC began

by breaking a project, such as building a military academy, into manageable elements that were supervised by an Engineer task force. In a detailed study, *A Plan for Project Planning*, the center described an orderly procedure applicable to any project.[94] This procedure was "a formal planning framework which integrates the full spectrum of administration, design, construction, funding, life support, logistics support, and GFP [government furnished property] activities inherent in a project."[95] Using this framework, ESC thought that MED could manage the projects more effectively, anticipate problems before they arose, and adjust more easily to changing requirements from the Saudis. After writing the plan for project planning, ESC sent a team of analysts to Saudi Arabia to help MED implement the plan in the design and construction of the King Abdul Aziz Military Academy.[96]

With the successful implementation of the first project plan, ESC recommended that MED complete its entire list of project plans while the center developed a system for project control. Frequent changes in project funding and design made project control an important subject. Because even small changes could significantly affect other aspects of a project, the project manager needed an automated control system to monitor progress and predict the effects of project changes. In a study published in August 1978, ESC outlined a control system that MED could operate.[97] The center's management studies helped MED to systematize its planning procedures and manage project implementation more effectively.

While ESC's management tools were relatively well received in MED, there was resistance, especially to the extensive use of computers. Recognizing this resistance, ESC followed a step-by-step approach in implementing the various tools to allow management participation in developing the systems and to minimize the disruption that the wholesale introduction of new procedures might cause.[98] "With regard to the internal workings of the MED organization, no outside consultant can be as thoroughly knowledgeable as the MED internal managers themselves. For this reason, ESC's most effective role has been that of a catalyst to develop the initial framework and assist in the application of MED expertise and detailed working knowledge to provide tailored, useful management products."[99]

From 1974 to 1977, ESC was attached to the Directorate of Facilities Engineering, OCE, and during that time, it did several studies of facilities engineering and real property maintenance activities. ESC's earlier work in this area had not continued because of declining Army budgets and the growing problems of providing adequate RPMA support. In April 1976 ESC published a study examining methods of determining the overhead costs of facilities engineering, which was the operation and maintenance component of RPMA.[100] With a decreasing work force due to budget cuts and an increasing demand for services, the Army had increased its reliance

on outside contractors for maintenance and repair. In order to compare the cost of contract and in-house work, however, the Army needed a method for identifying "those expenses which are not directly associated with a specific product or service."[101] The study outlined two methods for calculating these overhead costs of doing work in-house and helped provide measures that could demonstrate which approach—contract or in-house—was most cost-effective.

In two major studies published in 1978 and 1979, ESC examined the broader question of consolidating RPMA for a number of installations or services. The Defense Department objective was consolidation of RPMA in those cases where it was cost-effective and did not impair the missions of the organizations involved. The two cases that the center examined concerned nine installations (primarily Army ones) in the Washington, D.C., area, and, on a larger scale, the three services—Army, Navy, and Air Force—in the Panama Canal Zone.[102] In both cases, ESC examined several approaches to consolidation but singled out one as best. For the installations in the National Capital Region, the study recommended that a single manager direct the day-to-day activities of the RPMA labor force but that the installation commanders be left in control of RPMA funding. In the case of Panama, the recommendations were broader. Again ESC recommended consolidation under a single manager, but only as a part of the consolidation and standardization of all base operating support for the three services. Because of the delays and controversy surrounding ratification of the Panama Canal Treaty, the center felt this consolidation should be postponed. ESC maintained, however, that its evolutionary approach to consolidation would minimize the transitional difficulties and lead eventually to long-term savings in Panama and possibly elsewhere.

Early in 1979 the center reviewed several proposals for improving RPMA, including one that called for the Corps of Engineers' Divisions and Districts to assume responsibility for providing RPMA to installation commanders.[103] Some of the proposals for substantial changes stemmed from a growing fear within some Army circles that RPMA was on the verge of collapse. ESC acknowledged that real property maintenance activities were subjected to growing pressures due to "increasing expectations, continued reductions in civilian manpower, growing technological complexity of facilities, and the need to support more rapid mobilization."[104] However, the center did not feel that collapse was imminent. ESC predicted "that continuation along the course of evolutionary changes (including greater reliance on contracting) will avoid collapse and will suffice for at least several years to come."[105] Meanwhile, a more ambitious program of testing various alternatives and improved data collection could help determine if major changes were required. For ESC, at least, the evolutionary approach in its two case studies, along with more careful study and analysis, seemed the most feasible and least disruptive approach toward solving RPMA problems.

In addition to its studies of RPMA for the Directorate of Facilities Engineering, ESC also studied the non-tactical generator (NTG) program, which was the responsibility of an agency within the Directorate. Non-tactical generators were sources of electrical power that were not organic to particular Army units. Concern with NTGs grew out of the war in Vietnam when the Army had difficulty in supplying electricity for its bases and installations. Tactical generators had proven inadequate and unreliable for such heavy power demands. In 1970 the Army had established an NTG program to provide and manage a pool of generators for future contingencies. Because circumstances had changed in the intervening six years, ESC reviewed the minimum insurance level and the characteristics of NTGs in stock. The study recommended raising the insurance level from 250 megawatts to 300 megawatts and called for replacing power barges with land-based systems.[106] A subsequent study by another agency concluded that the 300 megawatts level was beyond Army capability. In a second study, the center examined a variety of contingency plans to determine the minimum requirements for the first stage of active combat in a war. The study recommended a minimum level of 175 megawatts and an active program to train NTG operators.[107]

In another management analysis published in April 1980, ESC turned to a much broader subject: the American contribution to military construction in Europe.[108] Construction funds for USAREUR came from three sources: U.S. Military Construction, Army (MCA) funds; the NATO Common Infrastructure Program; and NATO host-nation funds. Congress had expressed concern about the backlog of construction requirements for USAREUR but had warned the Defense Department that it should try to obtain funds from host nations or the Infrastructure Program. In addition, Congress had asked the military to reduce its share of the NATO program. ESC examined the funding for the program and found that while the United States contributed almost 68 percent of the NATO budget in 1977, it bore only 27 percent of the burden for the Infrastructure Program. After investigating alternative methods of assessing contributions to the program, the study concluded that "when the Infrastructure Program is examined, it appears that the U.S. is not paying an excessive share for its participation. Unlike the burden it carries for NATO as a whole, the U.S. is probably getting a 'good deal' in the Infrastructure Program."[109]

About one-quarter of ESC's studies in the late 1970s were devoted to management analyses for the Corps of Engineers. Both the emphasis on management studies and on Corps sponsorship represented changes for ESC. Now the center focused more on qualitative and Engineer-related studies than ever. ESC studies influenced the organization of Corps headquarters and field agencies, the management of the work force, planning in MED, and the management of RPMA. Although the topics were diverse, they reflected a growing interest in the variety of management problems that confronted the Engineers.

* * *

As management analysis became a larger part of the ESC workload, other agencies outside of the Corps of Engineers turned to the center for assistance. In the early 1970s most of these studies concerned drug abuse. Later they covered a variety of topics ranging from homeownership to the Combined Arms Center. Perhaps the most significant of these management studies for agencies outside the Corps concerned a topic with which ESC was very familiar: the Army study system.

By the late 1970s a substantial number of Army studies and analysis agencies existed. Some, like the Concepts Analysis Agency, were subordinate to the Army staff, while others, like ESC, were attached to major commands. In addition, the Army also relied on a number of private contracting firms. As the Army study resources grew larger and more varied, certain questions almost inevitably arose. Among the most difficult to answer were those concerning the effectiveness of the results and uses of studies. In 1976 the Director of Management in the Office, Chief of Staff of the Army asked ESC to study this problem.[110]

ESC evaluated a sample of 145 studies completed or terminated in FY 74 and 75. The data came from questionnaires sent to study agencies, in-house and contract, and study sponsors. One of the primary goals of The Army Study System (TASS) was to produce studies with usable results. But as the center pointed out, isolating one study as the primary catalyst for a particular change was often difficult: "Decisions at all levels are generally complex. Specific decisions are a result of many compromises among competing decisions. It is difficult—and will remain difficult—to single out a specific decision and say 'that one was different because of a study.' "[111]

A study's importance was often based on the rank or prestige of its sponsor instead of on its results. ESC noted a "tendency at all levels to equate a study's importance to the hierarchical position of the requestor. There is no generally used mechanism which establishes priorities regardless of study origin and based on program goals, substance, or issues addressed."[112] Because TASS was decentralized and its program was established by staff agencies and major commands, the studies produced by the system at times lacked clear themes and focuses. ESC concluded that "if the Army wants to ensure that its critical issues are studied, these issues must be identified and resources programmed accordingly. The identification should be by top management."[113] According to ESC, a study's importance should be related to the issues it addressed and not to its sponsor's status.

In evaluating study results, ESC relied on the questionnaires and admitted that some respondents "may have been overly generous."[114] The responses did allow the center to identify reasons for a study's failure to meet its objectives. Often a study had too many objectives, and at times the

methodology used was incapable of solving the problem.[115] The principal cause of failure was changes in the structure or personnel of the sponsoring organization or study agency: "Low return on study resource investment is associated with discontinuities in study management (changes in action officers, sponsor representatives, SAG [Study Advisory Group] principals, or in the study agency). Their differing perceptions of the original problem and anticipated uses caused on-going studies to flounder and even successful studies to be less than fully used."[116] Within a study agency, "failure is due primarily to loss of expertise/capability by promotion, transfer, retirement, or reduction in budget."[117] The lack of consistent pursuit of study objectives by a stable group of participants most often resulted in failure to meet a study's objectives.

In evaluating the uses of study results, ESC found some of the same problems: "Nonuse was most frequently related to changes in the personalities involved."[118] Even a study that was judged successful in achieving its objectives may not be used: "Study results are more likely to be used if the study management principles are the same from inception to implementation, if the results do not require acquisition of large amounts of new data in order to be effective, if appropriate authorities take approval actions expeditiously, and if the results are delivered on time."[119] In addition to the continuity of personnel, there was also a need for continuity of sponsor interest.[120] In the decentralized Army study system, a study's success of results and use depended heavily on the continuity and interest of those involved with the study, particularly its sponsor.

Two years later, in 1978, the Army staff again asked ESC to examine the Army study system as part of the broader "Review of Army Analysis" conducted by a high-level Army committee. Ironically, this committee threatened to abolish ESC and merge its personnel with other Army study agencies.[121] The project assigned to the center, however, examined the study management functions that should be performed at the Army staff level and the organizational structure needed to accomplish them.[122] As it had done two years earlier, ESC acknowledged that TASS was hard to define: "Practical definition is complicated by varied guidance, by tendencies to protect institutional territories and prerogatives, by funding requirements, and by rivalries among different kinds of 'analysts.' Efforts to preserve distinctions between research and study, between 'hard' and 'soft' or between study-like and staff-like have always left gaps and ambiguities."[123] As a result and "by its own admission, the Army cannot account quickly, accurately, and comprehensively about study-like activities. And outsiders confess to puzzlement at what the Army includes and excludes as 'studies.' "[124]

According to ESC, this situation required stronger planning, execution, and evaluation of the study program. Although the center did not

specify organizational arrangements, it felt that a highly placed "management cell" should exercise broad supervision and authority over the study program without destroying its decentralized character. The cell would ensure that study program development supported the Army decision-making process, that the studies would be timely and usable, and that they would be closely tied to the Army's long-range objectives and planning.[125] In terms of program and budget control, the cell would exercise "broad study budget authority," and would be responsible for assigning high-priority Army studies.[126] Finally, the management cell would take an active role in evaluating the results and uses of studies. Beyond the authority to assign a small proportion (10 to 15 percent) of a study agency's resources to high-priority studies, the cell would not usurp Army staff or major commanders' control over their study agencies. Because the study incorporated both centralized and decentralized concepts of management, it was controversial, and most of ESC's recommendations were not implemented.[127] Both ESC studies of the Army study system, however, cited many of the weaknesses and problems of the system. Some of these were due to organizational and management problems; others were perhaps inherent in the activity itself.

In addition to the analyses of the Army study system, ESC also produced management assessments for agencies outside the Corps of Engineers. In 1976 the center published a preliminary analysis of a proposed program to make homeownership more attractive to military personnel, and in 1977 it assessed the organization and activities of the Combined Arms Center at Fort Leavenworth.[128] The center also examined family housing and facilities engineering problems confronting the Military District of Washington (MDW). The study concluded that MDW needed a more clearly defined set of objectives for performing RPMA on family housing and that it needed to reorganize the agency responsible for RPMA.[129] As had been the case in the RPMA studies for the Corps, ESC felt that RPMA could be improved by better management.

In 1979 ESC completed a broader survey of facilities support policy for Robert Komer, advisor to the Secretary of Defense on NATO affairs. Ambassador Komer expressed his concern to General Morris about problems associated with military construction in NATO and the generally inadequate recognition of facility support problems in the Defense Department Consolidated Guidance. General Morris asked ESC to review the 1979 Guidance and suggest improvements. Although the costs of providing adequate facilities were small compared to other military costs, ESC felt that these facilities were crucial to military deployments and failure to provide them could delay an adequate military response.[130]

In its studies of the Army study system as well as in the management analyses for other Army agencies, ESC brought to bear the principles it had used in management studies for the Corps of Engineers. ESC stressed the formulation of clear goals and objectives, the improvement of management

structures, and the implementation of effective control and monitoring systems. Although management analysis was a somewhat qualitative and subjective field with fewer objective and well-accepted principles for judging alternatives, the center believed that careful planning and reasoned analysis could improve an organization's performance.

* * *

In the fall of 1978, the Department of Defense conducted the first large-scale mobilization exercise since World War II. Mobilization was not a subject that had attracted much attention in the military establishment since the limited callup of reserves during the Korean War. President Johnson had rejected the activation of reserves during the conflict in Southeast Asia, and in the early 1970s the decline of military budgets had precluded mobilization exercises. Then the Arab-Israeli War of 1973 further undercut interest in mobilization, because many military strategists felt that the short, violent war had demonstrated that the next conflict would be a "come-as-you-are" war. The late 1970s brought a revival of interest in mobilization planning and the result was "Nifty Nugget"—the government-wide mobilization exercise held in November 1978.[131]

Although the lessons of Nifty Nugget were many and varied, the overall impression created was that the nation was ill prepared for a real mobilization. The exercise revealed serious shortages in manpower, equipment, supplies, and transport to the European theater. Even more serious, however, were the difficulties encountered in shifting the civilian economy from peacetime production to support of the war effort. It is, after all, the economic strength of the United States that gives it an edge over the Warsaw Pact countries. Nifty Nugget vividly demonstrated that if a future war required mobilization, the United States was not prepared.[132]

While the exercise revealed serious deficiencies in the ability of the Corps of Engineers to mobilize effectively, the Corps had another reason for a keen interest in mobilization planning. Presidents Carter and Reagan had threatened to strip the Corps of its civil works functions. In response the Corps maintained that civil works provided the training and the manpower to support mobilization. So Nifty Nugget simply provided additional impetus to the Corps' interest in mobilization.[133]

In 1979 General Morris instructed ESC to examine the Corps' preparation for mobilization and measures to improve it. The result was a series of monographs published in 1979 and 1980. The first, *Mobilization Environments*, introduced the subject of mobilization to Corps' personnel.[134] Since the last full-scale mobilization had occurred almost four decades earlier, conditions had changed enough to make that mobilization an inadequate model. During World War II, the nation had mobilized relatively slowly within a protected base, but given the improvements in

weaponry and transportation, future mobilizations would have to be more rapid and the United States could not be sure that it would not come under devastating attack. In the future, the country could ill afford to be unprepared.

Defense policy defined three types of mobilization—full, total for conventional war, and total for nuclear war. Full mobilization called for expansion of the active Army by the activation of all reserve units in the approved force structure and the mobilization of the resources needed to support them. Total mobilization included the conditions of full mobilization with the addition of troops and resources to the extent required by the war (see figure 38). Many American contingency plans, including those for a war in Europe, required full mobilization, and while American strategists expected some warning before mobilization began, the Corps of Engineers could not implement its plans without a declaration of a national emergency. As a result, the Corps would have to be prepared to move quickly when mobilization was ordered. Military planners assumed that total mobilization for conventional war would most likely occur after full mobilization. While full and total mobilizations for conventional war bore some resemblance to earlier American experiences, total mobilization for nuclear war was completely different. Nuclear war could result from the escalation of a conventional conflict in progress or it could come with little or no warning. The first concerns after a nuclear attack would be recovery and survival. Mobilization for a nuclear war was the most difficult situation and the hardest to anticipate, while the two conventional mobilizations could be seen as a continuum.

The second monograph in the series attempted to describe in more concrete terms the tasks that the Corps would have under the three conditions of mobilization.[135] In ESC's opinion, the Engineers most important priority would be construction:

> Current mobilization planning has become obsessed with the preeminent importance of manpower; and as this obsession grows, other vital factors of mobilization support ebb in importance. To some degree, production base problems are considered in defense plans, but planning and posturing for the surge in construction which must precede a production base and manpower surge are nearly forgotten. This consideration must be championed by the Corps planners if the Army is to respond adequately to national defense needs.[136]

When national authorities declared mobilization, a flood of reservists and new inductees would stream into Army bases, which probably would not have sufficient facilities to accommodate them. The Corps would need to know how many people were expected and prepare to begin expanding military installations at the moment of mobilization. At the same time, the Army would need to increase production of ammunition and military equipment and might require construction and other measures to increase

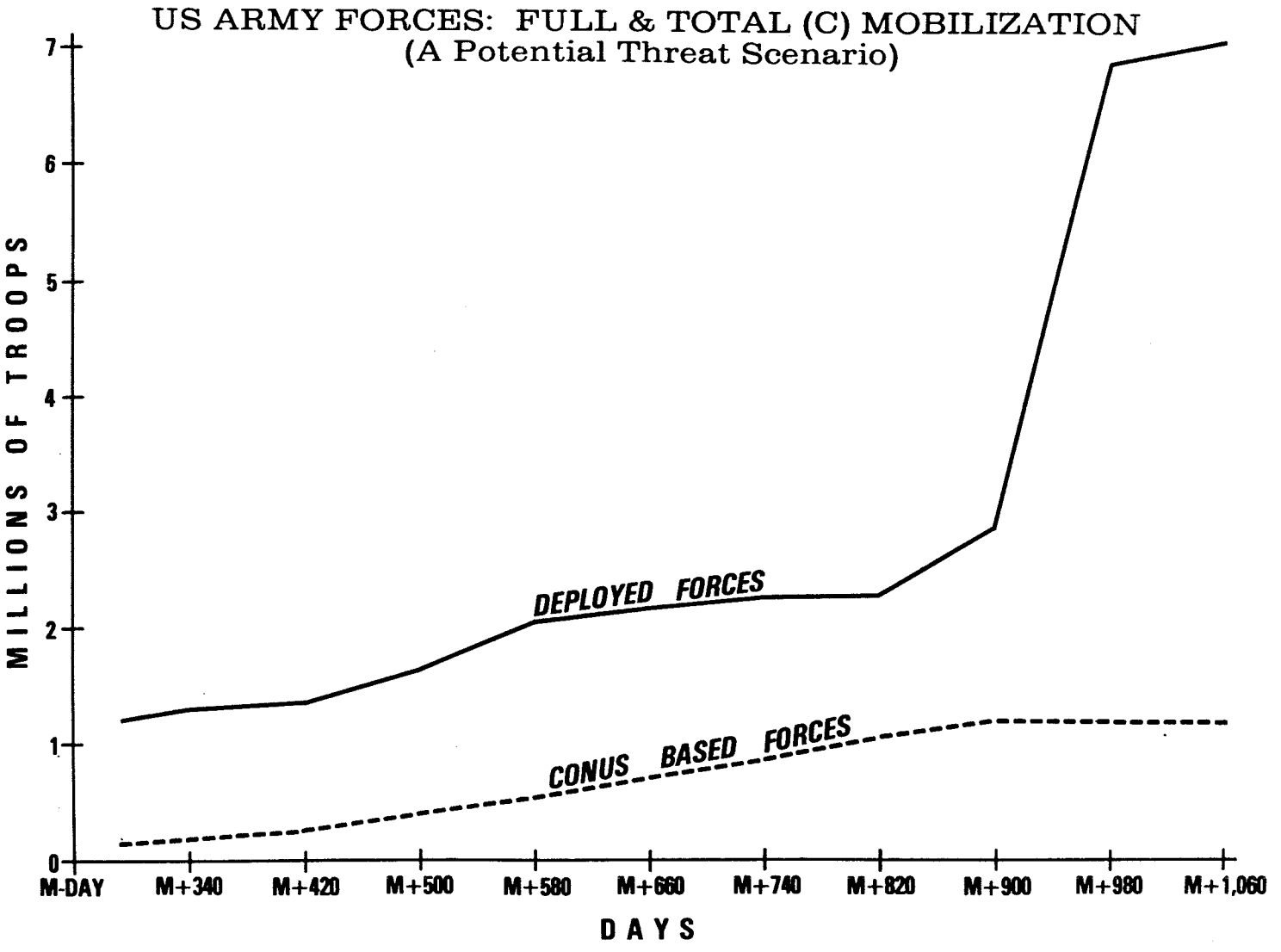
US ARMY FORCES: FULL & TOTAL (C) MOBILIZATION
(A Potential Threat Scenario)
MILLIONS OF TROOPS
7
6
5
4
3
2
1
0
DEPLOYED FORCES
CONUS BASED FORCES
M-DAY
M+340
M+420
M+500
M+580
M+660
M+740
M+820
M+900
M+980
M+1,060
DAYS

Figure 38

the military production base. In order to transport both men and materiel, the Army would depend on the Corps to improve and enhance the transportation system, including railroads and ports. The manpower and military production surges would require substantial construction and enhancement of facilities, and this task would fall upon the Engineers.[137]

To accomplish its mobilization tasks, the Corps would have to rely heavily on its civilian employees, most of whom were involved with civil works in peacetime. ESC estimated that about 75 percent of civilian personnel would be available for mobilization tasks while the remainder would have to continue critical peacetime activities such as operating locks and dams. All Corps employees, civilian and military, needed thorough preparation for their mobilization duties. ESC estimated that some 23,000 employees would need mobilization training. Under any mobilization condition, the Corps would have to respond quickly with its existing work force, and it was critical that the employees be prepared to undertake their assignments immediately.[138]

In planning for mobilization, ESC thought the Corps should recognize that there would be a variety of requirements and customers in different geographic areas. Because the Divisions and Districts would perform the bulk of the work, each one needed its own particular and individual mobilization plan geared to its own tasks. According to ESC, these plans should not be viewed as static documents, but rather should be kept viable through periodic exercises and reevaluations. Moreover, "key personnel must be aware of their mobilization roles and trained to move into such functions with no lost motion."[139] ESC concluded that "the Corps must bring its considerable resources to bear on mobilization problems within hours after mobilization is declared." In order to perform these tasks effectively, Corps elements "must analyze the problems in detail, determine the workloads, and allocate the trained resources."[140]

The third monograph in the series outlined specific measures that could improve the Corps' ability to mobilize.[141] Although the monographs emphasized the Corps' deficiencies, the center felt that the Corps still had a substantial mobilization capability:

> The Corps derives significant strength for mobilization from the nature of its peacetime business, particularly from: the size of the Civil Works program; the decentralized management structure; the continual emergency readiness for natural disaster; the synergism that exists between the Corps civil and military functions; and the working relationships existing with the U.S. construction industry.[142]

In spite of these strengths the Corps needed to devote a large effort to preparing for possible mobilizations. Because the Engineers would do most of their work for other military and government organizations, ESC urged the Chief of Engineers and the Divisions and Districts to take an active role

in contacting potential customers and persuading them to specify the tasks they would expect the Corps to perform. The Corps should also take specific measures to reduce its response time by determining which nonessential Corps construction projects should be discontinued at mobilization, by streaming procedures used in mobilization construction, and by preparing plans for predesigned facilities, like those in the Army Functional Components System, which could be erected quickly. ESC wanted clear definition of the concepts for advanced mobilization planning so that each Corps element understood its mobilization mission and the measures needed to prepare for it. All of these actions required a greater commitment of Corps money, manpower, and time—particularly in the areas of advance planning and training. Since past mobilization experience indicated that the construction workload would be huge, ESC argued that national authorities needed to determine which agency would be in charge of mobilizing the contract construction industry. Finally, ESC suggested a series of actions, including a high-level planning conference, which the Corps should take in the next few months to improve its mobilization posture.[143]

While the Corps was in the process of implementing many of ESC's suggestions, it participated in Exercise Prize Gauntlet held in March 1980. The exercise was concerned with a nuclear attack on the United States, a possibility that required a great deal more planning.[144] In a report on the exercise, ESC's commander, Colonel Richard T. Robinson, made a series of recommendations for improving the Corps' performance, but stressed the Corps' need to involve itself more actively in Army mobilization planning and exercises. According to Colonel Robinson, "many planners at Army headquarters were largely unaware of USACE [U.S. Army Corps of Engineers] capabilities or even that USACE has MACOM [major Army command] status and responsibilities. The USACE is still viewed as the Corps of Engineers—a peacetime, civilian-staffed organization that has limited utility in time of war."[145] Through an energetic role in mobilization planning, Colonel Robinson felt that the Corps could improve its image in the Army.

With the active encouragement of General Morris, the Corps began implementing ESC's recommendations and preparing for the fall 1980 conventional war mobilization exercise (MOBEX). In March 1980, representatives from all Corps elements attended an Action Planning Conference. The conference considered ESC's recommendations and drew up a long list of tasks for the various elements, even though most of the tasks would be completed after the fall MOBEX. The Engineers established a mobilization planning office in the Directorate of Civil Works and this office developed the USACE Exercise Plan (EXPLAN).[146] In an evaluation of this plan, ESC praised its emphasis on Corps field elements and its attention to determining mobilization requirements. The evaluation did recommend a greater

emphasis on training, especially at the District and Division levels, and closer monitoring of the newly established Emergency Management Organizational Element (EMOE). Because the funding for the 1980 MOBEX was limited and the time since the conference was short, ESC urged all elements to think in terms of lessons to be learned for future MOBEXs.[147]

In late 1980, ESC observed MOBEX 80 and wrote two evaluations of the exercise.[148] The most encouraging sign, according to the center, was a heightened awareness of mobilization throughout USACE and the increased participation in the exercise. As expected, the Corps needed improvement in a number of areas. Corps elements had attempted to ascertain the requirements of their various customers, but these requirements needed more precise definition and the Districts and Divisions needed a clearer understanding of which nonessential construction projects should be shut down. While some of the operating concepts for mobilization, such as "one-stop" service, had been implemented, they were not well known or understood. One-stop service, for example, was important because mobilization customers could go to one District office in their area and obtain all the support that the Corps had to offer. ESC reiterated the need for more money and the need to work with the Federal Emergency Management Agency (FEMA) to establish which agency, preferably the Corps, was in charge of mobilizing the contract construction industry.[149] In summary, ESC noted that "although USACE has begun to improve its mobilization posture, it has some distance to go before that posture is adequate."[150]

In October 1981, the center returned to the subject of mobilization in response to personnel reductions in civil works ordered by the Reagan administration.[151] Because civil works personnel provided the bulk of the mobilization work force, ESC attempted to predict the effect of the reductions on the Corps' mobilization capability. After making estimates of the workload required by full and total conventional mobilization, ESC calculated that the Corps work force would fall far short of the requirements, but that the Corps employees would constitute a solid base upon which to build. The study concluded with a list of alternative methods for handling the "mammoth construction responsibilities associated with any mobilization."[152] Although none of the alternatives was adequate, ESC felt that developing preliminary designs for military and production facilities, obtaining standby authorization for rapid recruitment of personnel, and "on-the-shelf" contracts with construction companies might help in case of mobilization.

By the end of 1981, ESC had been deeply involved in mobilization planning for a little longer than two years, but it had already produced nine monographs and reports. The intensity of the effort demonstrated the growing commitment of the Corps of Engineers to mobilization planning—a commitment that had put USACE, according to some sources, in

the forefront of the Army's revival of interest in the concept of mobilization.[153] Although the Corps still had much work to do, ESC felt that successful mobilization required detailed and meticulous planning. Because so much time had elapsed since the last American experience with mobilization, and the demands of mobilization could be so drastic yet so critical, it was incumbent on the Corps and the Army to give mobilization serious consideration.

* * *

While studies in military engineering, management analysis, and mobilization planning accounted for about three-fourths of ESC's published works in the late 1970s, the remainder of the studies from the period covered a wide variety of topics. Although ESC's work had shifted heavily toward Engineer and Engineer-related subjects, the center still did some work in many of the areas that had previously occupied more of its attention. Some of these areas, such as nuclear weapons and special engineering, seemed destined to disappear from ESC's repertory, but others, such as Army stationing and logistics, appear likely to return occasionally. These studies seem to have little in common, but their existence is testimony to the rich and varied study legacy of ESC's past.

It was perhaps appropriate that the last ESC study of nuclear weapons was about atomic demolition munitions (ADMs), now called nuclear cratering devices.[154]ADMs had been a particular concern of the Corps and ESC since their appearance in the early 1950s, due largely to their intended role in creating obstacles. ADMs and barrier planning had been closely related themes for almost 30 years. Both had come under frequent attack within the defense establishment and presented unresolved problems.

As the result of a series of decisions made in the mid-1970s, the Defense Department appeared ready to phase out the ADM program, and the Deputy Chief of Staff for Operations (DCSOPS) once again asked ESC to examine the ADM's role in future wars.[155] When the Army attempted to justify the ADM, it ran into many of the same problems encountered in earlier efforts. The chief function of ADMs was to produce obstacles, but the utility of obstacles on the battlefield was still unresolved. ESC acknowledged that the contribution of obstacles remained "unquantified and unquantifiable with the analytic tools available at this time."[156] Acknowledging that obstacles cause delay, the Office of the Secretary of Defense (OSD) asked if the delay would be enough to affect the outcome of battle.[157] "The opinion most frequently expressed to the study team in its initial research was that the Army had failed to show how ADMs would be used in the total tactical scheme."[158] ESC admitted that very few weapons had been studied as much as the ADM, but a consensus on its utility, even within the Army, had not been reached.[159]

Once again ESC developed European scenarios for the use of ADMs and examined their battlefield role. Based on the results of the war games as well as on political and technological considerations, the center concluded that there was no overwhelming tactical requirement for ADMs.[160] The conclusion provoked considerable controversy within the Army and within the Corps, but after a long history of analyzing the weapon, ESC felt that conditions had changed sufficiently to obviate the need for a weapon that one former ESC analyst had called "the Corps' bomb."[161]

In the year prior to the publication of the ADM study, ESC completed its last study to date of force requirements.[162] In the period since the publication of the center's first study of force requirements in 1962, computer simulations had become the preferred technique for performing requirements studies. ESC noted that "adopting any model introduces an element of inflexibility. Because of the Engineer Studies Center's experience in manual and computer-assisted analysis,"[163] DCSOPS asked the center to develop land force requirements to assist in the defense of South Korea. The results of this study played a part in the decision during the Carter administration to withdraw certain American units from South Korea.

In 1980, ESC returned to the subject of force structuring, which had begun in the early 1960s with the Force Planning Guides. The *Combat to Support Balance Study* (CSBS) grew out of the old concern that the Army had too many support troops and too few combat troops.[164] The Concepts Analysis Agency (CAA) presided over the study, which OSD had commissioned, and ESC completed the volume on engineering. In order to determine the number of Engineer troops required, ESC examined the Engineer tasks on the European battlefield, arranged them according to priorities, and determined the number of units and the amount of host-nation support needed to complete them. CSBS concluded that more Engineer troops were needed in Europe, and that the combat role of Engineer troops generated this requirement: "As the mobility of forces and the lethality of weapons have increased, more engineer support has been moved forward to fight with and support the committed maneuver units."[165] According to ESC, Engineer troops on future battlefields would be more "tooth" than "tail."

The Yom Kippur War of 1973, which had convinced many military observers that war in the future would be more violent and lethal, had also raised questions about the American ability to deploy troops and supplies overseas in an emergency. In his foreword to an ESC study, General John W. Vessey, Jr., then DCSOPS and later chairman of the Joint Chiefs of Staff, defined the problem as "the apparent ease with which either base operating rights or overflight rights can be lost in time of crisis, such as in the 1973 Mideast War."[166] General Vessey asked ESC to produce a study that would help the Army determine the strategic deployment bases it would need for future contingencies. In an analysis similar to its earlier

strategic mobility studies, the center examined 22 contingencies worldwide (except for NATO), calculated the American forces required in each, and determined both the sea and air bases that would most effectively support troop deployments in these areas. The study evaluated each potential or current location in terms of its ability to support the deployments, the political constraints that might hinder its acquisition or use, and the cost of development. Overflight and landing restrictions and the loss of free passage in international waters were critical factors considered by the study. The three-volume study brought together a large amount of data on strategic deployment and identified "the type, location, and physical characteristics of strategic mobility bases required to support a wide range of contingencies during the 1980 to 1990 period."[167] In the late 1970s, American strategists were reviving the concern for strategic mobility that had appeared a decade earlier.

While ESC's interest in strategic mobility had appeared in the mid-1960s, the center's involvement with logistical problems dated to the origins of the organization during World War II. Logistics has never been ESC's primary subject area, but the center has done studies in this area throughout its history. In 1976 questions rose in the Army about the ability of industries to supply spare parts for weapons systems acquired by both the Army and the many foreign nations that had purchased American military equipment. In a three-volume study for the Deputy Chief of Staff for Logistics (DCSLOG) published in 1977, ESC investigated the problem and discovered that the demand of foreign customers "has caused problems in repair part support to U.S. forces. Although these problems were not serious enough to reduce U.S. readiness, readiness improvement rates were slowed."[168] The cause of these problems was not the American industrial base, which was "adequate to satisfy peacetime repair part requirements in the FY 77-81 time frame,"[169] but instead the problems resulted from the repair parts program's management. According to ESC, however, these difficulties could be reduced by consolidating responsibility for the program in one office and by "improved forward-looking supply management techniques."[170] With improved management, better projections for the future, and the provision of adequate and timely funding, the foreign demand for spare parts should not seriously threaten the readiness of the Army.

In 1978, ESC completed another logistics study for DCSLOG concerning a topic that the center had studied on several occasions in its past. Both prepositioned overseas materiel configured to unit sets (POMCUS) and prepositioned war reserve materiel stocks (PWRMS) were critical to American planning for a war in Europe. POMCUS would allow rapid reinforcement of the combat line and PWRMS would provide the replacements for early combat consumption and losses. DCSLOG asked ESC to determine if peacetime management of these systems should remain with

USAREUR or should be transferred to the Development and Readiness Command (DARCOM). While there were problems with both systems, ESC felt that these resulted not from poor management, but rather from the more stringent requirements necessitated by a short-warning, intense-combat scenario. The new Army orientation toward a European war, with less warning than previously assumed and huge casualties in the initial intense battle, meant that both systems would now have to be activated more quickly and efficiently and that the projected heavy requirements of the first battle would seriously strain both systems. ESC concluded that relatively minor changes could correct any deficiencies and that peacetime management should remain in the hands of USAREUR because that command would have control of both systems in the event of war.[171]

The logistical problems associated with a war in Europe prompted another study published in October 1978.[172] DCSOPS asked ESC to determine how long NATO could continue a conventional war if Middle East oil supplies to Europe were cut off and, if oil supplies were available, how effectively the NATO fuel distribution system could deliver the types of fuel required to the appropriate locations. In answer to the first question, the study discovered that NATO would experience a severe fuel shortage if Middle East oil supplies were interrupted.[173] Even if Mideast oil were available, the study also concluded that there were "serious deficiencies in NATO's primary wholesale fuel distribution system."[174] Although there were a number of reasons for these deficiencies, including inadequate attention to the subject and the increasing fuel requirements for a European war, General David C. Jones, chairman of the Joint Chiefs of Staff, singled out an important political and strategic factor in testimony before a congressional committee: "U.S.-owned and NATO pipelines in France are the primary petroleum lines of communication for central Europe, bringing fuel from French ports to military installations in Germany. A recently completed study by the U.S. Army Engineer Studies Center concludes that without the pipelines and storage facilities in France, it would be difficult to support a war effort in the central region of Europe."[175] (See figure 39.) The study then made a number of recommendations that could "markedly improve both the fuel availability and the distribution system."[176] Both the availability of fuel and the adequacy of prepositioned war reserves would be critical factors in a European war.

While ESC had done logistical studies since its origin, its studies of Army stationing had begun in the early 1960s with the lengthy study of the Army's requirements for division-sized posts and the suitability of Defense Department real estate to fulfill these requirements. In response to a House of Representatives' directive in 1975, the Army asked ESC for a similar study of division and brigade stationing.[177] Using a similar approach, ESC defined the criteria for stationing units to posts and then evaluated 37 Army installations in order to determine their current utilization and potential for

WESTERN EUROPE PETROLEUM PIPELINES

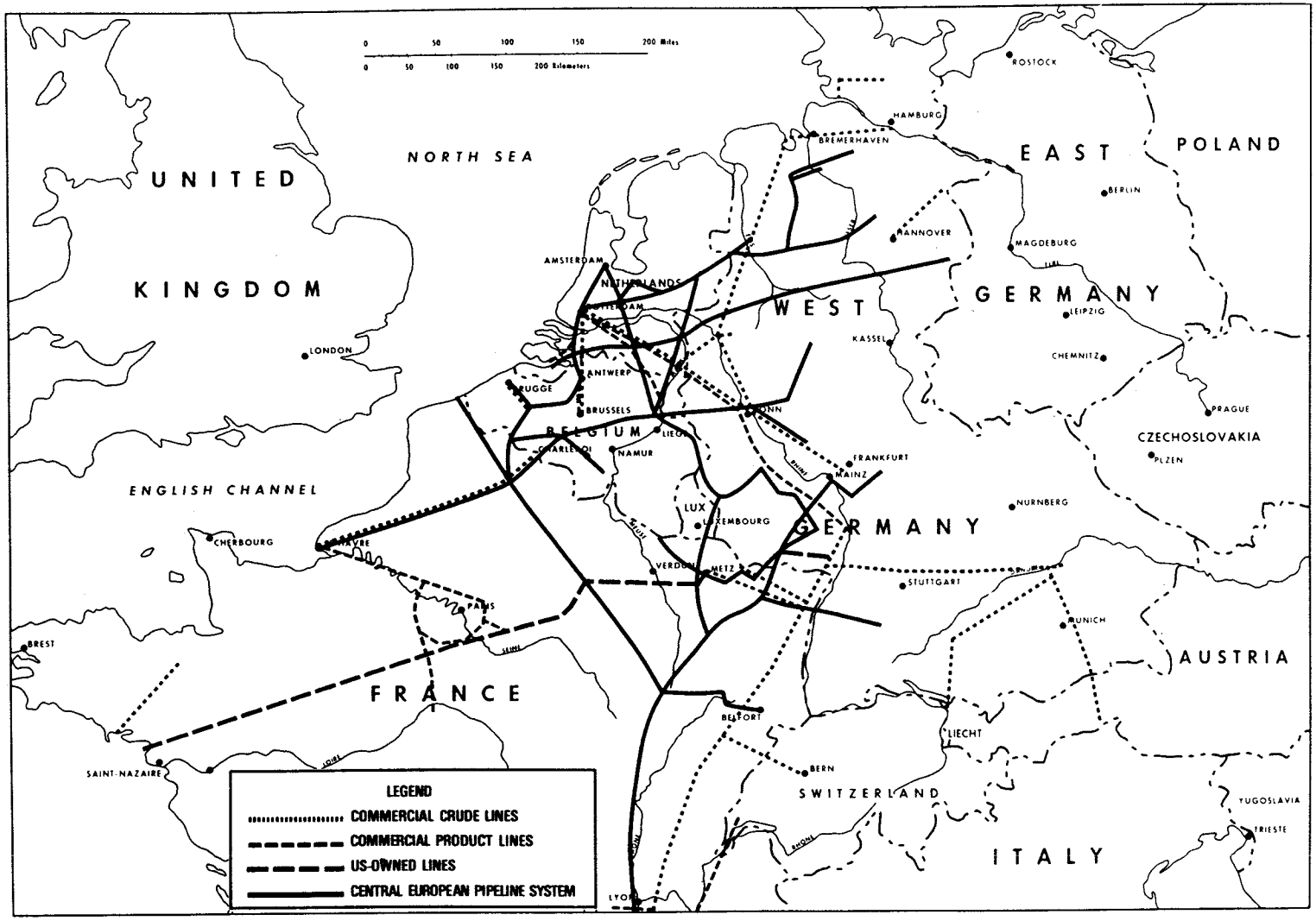

Figure 39

alternative purposes. While the study found that some installations had shortages or excesses of support facilities, such as housing, most installations operated near capacity. Taking into consideration that the Army had seen its budget and strength reduced by about 30 percent in the previous five years, ESC felt that the stationing decisions had been relatively sound. In response to budget and strength reductions, the Army had proposed several base realignments. But pressure from local communities, which feared economic hardship, derailed these efforts. Although ESC believed that the economic dislocation was often exaggerated, the center concluded that "the Army must continue to do more with less—more intensively utilizing its already developed multimission installations and complexes while eliminating those which are inefficient or single-mission oriented."[178]

Four years later ESC returned to the subject of Army stationing in a study that evaluated the Army's procedures for estimating and monitoring costs and savings associated with base realignments.[179] Prior to the mid-1970s the Army had an ad hoc set of procedures that were uneven and inconsistent, but later in the decade standardized and systematized the procedures. Parallel to the ESC study effort, the Army was again updating and revising its procedures, which the study found to be relatively adequate. ESC recommended a few changes, including some that would reduce the paperwork, but in general the center felt that "the time is right for stabilizing the methodology."[180] The amount of documentation required for realignments was already substantial and "considering the significant, if not overwhelming, impact of politics on ultimate decisions, it would probably be wasteful to go any further in refining the process."[181]

The center's most recent and perhaps most controversial study of stationing was the plan to move American forces in West Germany closer to the border with Eastern Europe. Army units in Germany are now located in bases that were occupied at the end of World War II. Although NATO's official strategy calls for a forward defense in Central Europe, most Army units are stationed at some distance from the frontier. In addition, the American facilities, particularly housing, are often old and shabby, and their location in crowded urban areas has led to strained relations between American soldiers and German civilians. As a result, American officials have urged the West German government to participate in a plan to move Army units to new bases near the frontier in exchange for the return of the old facilities to the West Germans.[182]

In a study prepared for DCSOPS and the USAREUR Engineer, ESC identified new sites for Army bases, calculated the requirements for facilities, and estimated the costs of the program. The study, *Long Range Stationing Strategy for USAREUR: An Army Deployed (UAD)*, chose new sites that contributed to the forward defense strategy and proposed two optional stationing strategies, neither of which would be completed before the year 2000.[183] The study was a major effort because of the large number of

Army units stationed in West Germany and the difficulties in estimating the value of existing American facilities and the cost of land for the new bases. Although the Reagan administration has given the plan high priority, the German government has voiced reservations.

Another subject of ESC's work that had begun in the late 1960s was special engineering. Because the techniques of satellite photography that characterized this field remained classified, the special engineering studies still related primarily to military topics. In 1975 the American command in South Korea had expressed "an immediate need for technical assistance in locating North Korean tunnels under the DMZ" and asked ESC to determine "if useful insights into tunnel identification could be gained through source material available in the Washington, D.C. intelligence community."[184] In a series of four studies, ESC developed criteria for site selection and located areas that were suitable for selective types of underground facilities. These studies, along with a barrier study completed in 1982 and an airfield damage study begun in 1982, indicated a growing ESC interest in providing support for the South Koreans.

The final group of ESC studies published in the late 1970s drew from a variety of topics that the center had pursued in the previous decades. The Base Development Planning Assistance Office continued its work, including a base development plan (BDP) for the Rapid Deployment Force. In March 1982 the center published a new BDP, now called a Civil Engineering Support Plan, for Europe. By the end of the decade the demand for BDPs from major commands had slackened. With the lessons of the war in Vietnam fading and the pressures of newer concerns growing, BDP no longer seemed to have the immediacy it had once commanded.[185] In 1978 the Chief of Engineers asked ESC to determine the number of dredges the Corps needed to retain in order to support potential military operations.[186] In another unusual study, the Deputy Chief of Staff for Personnel asked ESC to examine the American experience with enemy prisoners of war during the Vietnam conflict and to recommend improvements in current plans for handling prisoners of war. The study concluded that "insufficient planning was the single, overriding cause of problems"[187] with POWs in Vietnam and recommended a series of measures to avoid problems in the future.

This diverse collection of studies, ranging from ADMs and force requirements to dredges and enemy POWs, had little in common except that they continued work that ESC had begun earlier in its history. Certain study areas, such as force requirements, force structuring, and Army organization, had largely passed to other agencies like CAA. Strategic mobility had been eclipsed by the war in Southeast Asia only to surface again in the late 1970s. Special engineering and base development planning seemed to be of declining importance in ESC's study repertory, while Army stationing in Europe, was, in 1982, the subject of an important ESC study effort. Even

though the diversity of topics had its origins in ESC's historical evolution, the particular subjects were of immediate interest to the Army.

* * *

At the end of the war in Southeast Asia, ESC, like the Army, turned its attention back to the European theater. In the mid-1970s, the center examined a variety of European military engineering problems, increasing its experience and expertise in the details of operation in that theater. This knowledge culminated in the broad and comprehensive *U.S. Army Engineer Assessment, Europe*, which sought to prepare Army Engineers for the huge task of helping blunt a Warsaw Pact attack, ESC's interest in Engineer problems in Europe continued after EAE and promised to remain a long-term preoccupation along with a concern for the military problems confronting South Korea.

The mid-1970s witnessed other substantial changes in ESC's orientation. The growing interest in military engineering and management analysis replaced the declining concern with nuclear and general purpose force studies in the center's repertory. As long-range, quantitative Army staff work passed to other study agencies, ESC turned to the more qualitative analysis associated with improving the Corps of Engineers' organization, planning, and management. While the center had been concerned with military engineering since its beginnings, the addition of management studies for the Corps and the new field of mobilization planning made ESC's workload more heavily Engineer-related than it had been for almost three decades. While somewhat jolting, the changes secured for the center a firm place in the realm of Army analysis.

Although ESC's study repertory had changed significantly in the 1970s, the almost random scattering of studies on subjects like ADMs, land force planning estimates, base development planning, and strategic mobility was testimony to the richness and diversity of the center's past and its adaptability to changing conditions. As its organizational and doctrinal environment changed, ESC maintained the flexibility to discover both new and neglected subjects that required careful and imaginative treatment. The legacies of the past became not laurels on which to rest, but incentives for adapting to the future.

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